focal or confluent areas of signal abnormality in the subcortical white matter and, sometimes, in subcortical gray matter on T2-weighted and fluid attenuation inversion recovery (FLAIR) sequences; the lesions are usually enhancing and display similar stages of evolution.

Electroencephalography is rarely specific for a given pathogen in patients with encephalitis, but results can be helpful in identifying the degree of cerebral dysfunction by detecting subclinical seizure activity, and it may provide information about the specific area of the brain involved. Many patients with HSV encephalitis demonstrate a temporal lobe focus with periodic lateralizing epileptiform discharges (PLEDs).

Lumbar puncture with CSF analysis (i.e., cell count and differential, glucose and protein levels) and a measurement of the opening pressure should be performed unless there is a specific contraindication. Most patients with viral encephalitis have a mononuclear cell pleocytosis with cell counts ranging from 10 to 1000/mm^3. Early in the disease process, CSF pleocytosis may be absent, or there may be an elevation in neutrophils. The CSF protein concentration is typically elevated, but usually less than 100 to 200 mg/dL, whereas the CSF glucose concentration is typically normal. CSF viral cultures are usually not recommended.

Brain biopsy has largely been replaced by CSF molecular tests. For certain types of infections, however, brain biopsy may be diagnostic. In rabies infections, for example, Negri bodies are a distinctive histopathologic feature. Intranuclear eosinophilic amorphous bodies surrounded by a halo may be seen in diseases such as HSV encephalitis.

Testing for specific agents includes laboratory methods such as antigen detection, culture, serology, and molecular diagnostics. HSV encephalitis is a treatable and relatively common cause of encephalitis, and an HSV PCR should be performed on the CSF of all patients with a clinical diagnosis of encephalitis. False-negative PCR test results can occur within the first 72 hours after onset, and if HSV encephalitis is strongly suspected (e.g., in a patient with temporal lobe involvement), a repeat HSV PCR on a second sample of CSF within 3 to 7 days is recommended. Enterovirus and varicella PCR should be done on CSF because they are also common causes of encephalitis; however, detection of antibodies to varicella-zoster virus in the CSF appears to have greater sensitivity than detection of viral DNA.

Testing for other agents should be individualized with consideration of the patient's exposures, travel, season of the year, and clinical and laboratory characteristics. Many infections require acute and convalescent (i.e., paired) serum samples to determine a diagnosis. A serum specimen collected during the acute phase of the illness should be stored and tested in parallel when the convalescent serum sample is drawn. Immunoglobulin M (IgM) and immunoglobulin G (IgG) capture enzyme-linked immunosorbent assays (ELISAs) have become useful and widely available for the diagnosis of arboviral encephalitis. Detection of intrathecal IgM antibody is a specific and sensitive method for the diagnosis of West Nile virus infection. There is substantial cross-reactivity among the flaviviruses (e.g., West Nile virus, St. Louis encephalitis virus, Japanese encephalitis virus); plaque-reduction neutralization assays may be helpful in distinguishing which flavivirus is involved in the event of elevated titers.

Serologic testing for *Rickettsia*, *Ehrlichia,* and *Anaplasma* species should be performed for all encephalitis patients during the appropriate season and with travel to or residence in endemic areas, especially because these are treatable causes. Empirical therapy should not be withheld from patients with a compatible clinical presentation because antibodies are not always detectable early in the course of illness.

Identification of NMDAR antibodies confirms the diagnosis of anti-NMDAR encephalitis and should lead to the search for a tumor. The tumor is almost always an ovarian teratoma.

Treatment

One of the most important first steps in managing encephalitis is to consider treatable causes. Specific antiviral therapy is usually limited to infections caused by herpesviruses (especially HSV-1 and varicella-zoster virus) and HIV. Acyclovir (10 mg/kg intravenously every 8 hours in adults with normal renal function) should be administered to patients with encephalitis. Empirical therapy for acute bacterial meningitis should be initiated when clinical and laboratory testing is compatible with bacterial infection. If rickettsial or ehrlichial infections are suspected, empirical doxycycline should be administered. The management of West Nile virus infection is supportive care.

In patients with suspected postinfectious encephalomyelitis (i.e., ADEM), high-dose intravenous corticosteroids (1 g of methylprednisolone intravenously daily for at least 3 to 5 days) are usually recommended, followed by an oral taper for 3 to 6 weeks. For patients diagnosed with anti-NMDAR encephalitis, treatments have included corticosteroids, intravenous immunoglobulins, and plasmapheresis. If a tumor is detected, removal is important because it accelerates improvement and decreases relapses.

BRAIN ABSCESS

CNS infections can manifest as abscesses in the parenchyma or as parameningeal infections. Prion infections produce clinical signs confined to the brain and spinal cord.

Definition

A *brain abscess* is a focal collection of infected material in the brain parenchyma that results in a necrotic center surrounded by inflammatory cells.

Pathology and Pathophysiology

Brain abscesses produce symptoms and findings similar to those of other space-occupying lesions (e.g., brain tumors), but they often progress more rapidly and affect meningeal structures more frequently than tumors. They originate or extend from extracerebral locations. Examples include blood-borne metastases from unknown sources, lungs, or heart (i.e., endocarditis); direct extensions from parameningeal sites of infection (i.e., otitis, cranial osteomyelitis, facial infections, and sinusitis); and infections from sites of recent or remote head trauma or neurosurgical procedures.

The infection is often polymicrobial. Commonly isolated pathogens are aerobic and microaerobic streptococci and gram-negative anaerobes such as *Bacteroides* and *Prevotella.* Less common are gram-negative aerobes and *Staphylococcus.*